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AUTHOR Goodfriend, Phyllis
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ABSTRACT

A study investigated the effects of nonverbal and verbal classification abilities on reading comprehension. Subjects, 104 fourth grade students, were tested on three measures of classification skill (a shifting of criteria task, a free sorting task, and a three-level hierarchical classification task) and on a measure of recall of relevant story aspects. Student IQ scores were also gathered from school records. Intercorrelations among IQ, recall, nonverbal, and verbal classification were computed and the data were submitted to multiple regression analysis with recall as the dependent variable and nonverbal and verbal classification as the independent variables. Results showed that the effect of nonverbal and verbal classification ability on reading comprehension as measured by recall was too small to be statistically significant when IQ was controlled. Although nonverbal classification explained more of the variance of recall than did verbal classification, this difference was probably due to an overlap in the amount of variance explained by both IQ and verbal classification. (FL)

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The Effect of Cognitive Organization Ability on Reading Comprehension

Phyllis Goodfriend

Hofstra University

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Abstract

The purpose of this study was to investigate the effects of nonverbal and verbal classification abilities on the reading comprehension of fourth-grade students. One hundred four fourth-grade students were tested on three measures of classification skill designed by the investigator specifically for this study, and on a measure of recall of the most relevant aspects of a story. IQ scores were obtained from tests previously administered at the four participating schools. Intercorrelations between the four variables (IQ, reading recall, nonverbal and verbal classification) were computed, and the data were then submitted to multiple regression analysis with reading recall as the dependent variable and nonverbal and verbal classification as the independent variables. IQ was found to contribute 20.13% of the variance of reading recall ($p < .01$). The amount of variance contributed by nonverbal and verbal classification together was small (.4%) and not statistically significant.

The Effect of Cognitive Organization Ability on Reading Comprehension

Phyllis Goodfriend

Hofstra University

Reading is more than the identification of words and the learning of sound-symbol relationship. It is the gaining of meaning from written discourse and, as such, is a cognitive process (Gibson & Levin, 1975; Stauffer, 1969; Thorndike, 1917). Philosophers and cognitive psychologists have long noted that cognition (Ausubel, 1968; Dewey, 1933; Kant, 1963/1787), memory (Bartlett, 1932; Miller, 1956; Neisser, 1967), language (Brown, 1958), and learning (Inhelder & Piaget, 1964/1957) are dependent on the ability to classify or on cognitive organization. Without this ability we would not be able to deal with the multiplicity of stimuli in our environment (Bruner, 1956). It follows logically, then, that if reading is dependent on cognition, and if cognition is dependent on organization, reading comprehension must be dependent on cognitive organization.

Three major thinkers of this century, Piaget (1941; Inhelder & Piaget, 1964/1957), Vygotsky (1932), and Bruner (1956) have developed theories of the development of classificatory ability as major parts of their overall theories of human cognitive development. Much subsequent research has been based on the work of these three major theorists,

particularly that of Piaget. A number of researchers have studied classification and reading, but have defined "reading ability" as the ability to recognize words. This reviewer has found only three studies of tasks of hierarchical classification and reading comprehension. The subjects in the three studies ranged in age from kindergarten to third grade. Gillett (1977) and Smith-Burke, Reid, and Nicholich (1967), in separate studies, found significant relationships between class inclusion tasks and reading comprehension items which were specifically chosen as being "high classification" or main idea items. Ross (1971), however, found no significant relationships between any of the classification variables and any of the reading comprehension variables in his study.

The seminal work for modern theories of memory and comprehension of discourse seems to be Bartlett's (1932) Remembering. Bartlett studied memory for stories by the method of repeated reproduction: a subject heard a story (Bartlett used "The War of the Ghosts") and repeated it after a day, a week, a year, and several years. Bartlett found that accurate reproduction was the rare exception. Bartlett's main conclusions were that "remembering is 'schematically' determined" (Bartlett, 1932, p. 312), and it is a constructive process. He defined "schema" as "an active organization of past reactions or past experiences" (p. 201).

Current "schema theories" of cognition and memory appear to be the direct descendents of Bartlett's "constructive" view of memory. Rumelhart (1980) has called schemata "the building blocks of cognition" (p. 33). According to schema theory, all knowledge is packaged into units called "schemata." The construction of "story grammars" has been a major outgrowth of recent reading research within the framework of schema theory. Rumelhart (1975), Mandler and Johnson (1971), Thorndyke (1977), and Kintsch and Van Dijk (1978), in separate studies, have developed story grammars based on the theory that stories have internal structures, just as sentences do. People have "story schemata," sets of expectations about the structure of stories. To the extent that a story violates the ideal structure specified by the rules of the story grammar, it will be imperfectly recalled, according to this theory. Mandler and Johnson found that children as young as six were sensitive to the structure of stories and had schemata for organizing and retrieving data.

Several investigators have attempted to measure objectively the recall of prose and to determine whether what was recalled was relevant or irrelevant to the gist of the story. Johnson (1970) devised a method whereby a prose passage was divided into meaningful subunits, and the subunits were calibrated as to their structural importance to the story as a whole. Johnson found that the structural

importance of the units was significantly related to recall at each recall interval--more important units were recalled more frequently than less important units. Christie and Schumacher (1975), Brown and Smiley (1977), and Smiley et al. (1977), in separate investigations, used procedures similar to that devised by Johnson (1970). All found that, although total amount of recall increased with age, units more relevant to the total gist of the story were recalled more frequently than units less relevant to the total gist of the story at all age levels.

Whether one uses the term classification, concept formation, or schemata, it would seem that one's level of cognitive organization may affect how well one recalls what one has read and how well one can distinguish between more or less relevant aspects of a story. The purpose of this study was to investigate the effects of nonverbal and verbal classification abilities on the reading comprehension of fourth-grade students, as measured by their recall of relevant units of a story. Since intelligence may be highly related to reading recall, this investigation was designed to control statistically for the factor of intelligence. It was hypothesized that a significant amount ($p < .05$) of the variance of reading recall would be explained by nonverbal and verbal classification, after controlling for intelligence.

Methods

Subjects

One hundred and four fourth-grade students ranging in age from 9 years, 0 months to 10 years, 7 months were tested. Fifty-five were male and 49 female. Their IQs ranged from 71 to 147, with a mean IQ of 116.6 and a median of 117.0. English was the language spoken at home for 85.6% of the subjects.

The subjects were selected from four schools located in three neighboring suburban communities: two public schools, one private schcol, and one parochial school. The two public schools and the parochial school were located in residential communites of medium to high priced individual homes, with some garden apartments. Although the private school was located in an area of high priced homes and large estates, the students did not necessarily live in the community in which the school was located. All three communities were generally considered to be above average socioeconomically. All fourth-grade students (excluding the handicapped and non-English speaking) in the four schools were tested, with the exception of one classroom in which the teacher declined to participate, and those students whose parents refused permission.

Instruments

The reading comprehension instrument used in this investigation was a measure of reading recall and of the

ability to identify the most relevant ideas of a story, as first developed by Johnson (1970) and subsequently used by Brown and Smiley (1977) and by Smiley et al. (1977). The story used was "Taro and the Bamboo Shoot" (Matsuro, 1975). In order to insure that word recognition and vocabulary would not be a factor, the story was taken from a second-grade basal reader. The readability of the story was measured using the Bormuth Formula (Bormuth, 1968), which specifies that a story is at the instructional level for a student if that student is able to supply correctly 44% to 57% of the deleted words of the story in a Cloze comprehension exercise. According to the Bormuth Formula, the story was at the independent reading level for 27% of a group of 18 fourth-grade students; at the instructional level for 57% of the group; and at the frustration level for 16% of the group. (These students were not included in the main study.)

As specified in the method devised by Johnson (1970), the 99 sentences of the story were divided into 152 subunits (pausal units) by a group of 11 graduate students in Reading. The students were asked to read the story and to place a slash (/) at each point where a reader might normally be expected to pause in the reading of the story. A pause was accepted by the investigator if it was agreed upon by more than 50% of the graduate students. One hundred fifty-two pausal units were delineated in this manner.

The 152 pausal units were then rated on a scale of one to four as to their relevance to the essence of the story by 29 graduate students in Reading. Eleven students were first asked to delete the 38 units least relevant to the essential meaning of the story. Their responses were tallied and the 38 units most frequently deleted were designated as Level Four (least relevant) pausal units. The story was then presented, with the 38 units deleted, to a group of 7 graduate students who were given the same instructions. After having selected 38 Level Three units by the same method as that used for Level Four, the procedure was repeated a third time with a group of 11 graduate students. The 38 units not deleted were designated as Level One, or most relevant.

Three measures of nonverbal and verbal classification designed by the investigator specifically for this investigation were used. For each measure of classificatory ability the subjects were scored for performance (nonverbal) and for explanation (verbal). The total possible score for all three tasks was 100 points for the verbal portion and 100 points for the nonverbal portion. All three tasks were patterned after those used by Piaget (Flavell, 1963, pp. 304-306; Inhelder & Piaget, 1964/1957, pp. 112-118).

The first measure of classificatory ability was a measure of Shifting of Criteria. The materials were a set of 18 two and one-half inch square cards, each with one of

three shapes printed on it: circle, square, or triangle. The shapes varied in color (red, black, or green) and in size (small, medium, or large). The subject was asked to sort the cards into three groups in such a way that s/he put together the ones that go together. S/he was instructed to repeat the procedure two more times, each time doing it in a different way, but in each case putting together the ones that go together. After each sort, the subject was asked to explain why s/he did it that way. Any explanation indicating that the basis of the sort was color, size, or shape was accepted as a correct explanation. Subjects received credit for each sort correctly completed (nonverbal) and for each correct explanation (verbal).

The second measure of classificatory ability was a Free-Sorting Task. The materials were 16 two and one-half inch square cards with blue line drawings of the following items: tree, flower, grapes, corn, bird, butterfly, fish, pig, desk, chair, TV, clock, train, ship, plane, automobile. The subjects were instructed to put together the ones that go together, making as many groups as they wish of any size they wish, and to explain their groupings.

The third measure of a classificatory ability was a Three Level Hierarchical Classification Task. The materials were 16 two and one-half inch square cards with colored pictures of the following items: cow, pig, banana, apple, dog,

cat, grass, flowers, pail and shovel, top, baseball bat, pegboard and hammer toy, airplane, rocket, taxicab, and bus. The subject was first asked to sort the cards into pairs (Level I sort). S/he was then asked to combine the pairs into fewer groups (Level II sort), and again into still fewer groups (Level III sort). At each level, the subject was asked to explain his/her groups.

The Free-Sorting Task and the Three Level Hierarchical Classification Task were scored as follows: responses based on class (they are all foods, vehicles, animals) received the most credit; responses based on attribute (they are red, wooden) or function (they fly, swim) received a lesser amount of credit; responses based on contiguity (the bird lives in the tree) received the least credit. No credit was given for incorrect explanations or enumeration (this is a ball and this is a bat). The highest possible score for all three tasks combined was 100 for performance (nonverbal) and 100 for explanations (verbal).

The IQ scores were obtained from tests previously given in each school district. In three schools the Short Form Test of Academic Aptitide (SFTAA) was used; in the fourth school the test was the Wechsler Intelligence Scale for Children--Revised (WISC-R). Both tests yield scores for nonverbal IQ, verbal IQ, and full-scale IQ. (Full-scale IQ scores were used in the present investigation.)

Procedures

The examiner was a certified teacher especially trained by the investigator. Each subject was tested individually in a private room. The examiner introduced the classification tasks as "card games." The order of presentation of the classification tasks was randomly counterbalanced.

When all three classification tasks were completed, the child was asked to read "Taro and the Bamboo Shoot" silently. When s/he finished reading the story, the examiner removed the story and then said, "Tell me everything you can remember about the story." The recall response was tape-recorded. The tape recording was later transcribed and scored for the number of Level I (most relevant) units present. Responses were scored for meaning--exact wording was not required. Word substitutions, omissions, and additions were accepted as long as the meaning was not changed. The highest possible score was 34.

Treatment and Results

IQ, reading recall, nonverbal, and verbal classification scores were tabulated (see Table 1) and correlation coefficients among these four variables were computed. The data were then submitted to multiple regression analysis with reading recall as the dependent variable, and IQ, nonverbal and verba. classification as the independent variables. IQ was found to account for 20.1% of the variance

of reading recall, F (1,83) = 20.9, p < .01. Nonverbal and

Insert Table 1 about here

verbal classification scores together contributed an additional .4%, F (1,81) = .44, p > .05. These results are summarized in Table 2.

Insert Table 2 about here

When the nonverbal and verbal classification scores were entered into the multiple regression analysis separately, nonverbal classification contributed .37% of the variance of reading recall with IQ controlled, F (1,82) = .38, p > .05; and verbal classification contributed .02%, F (1,82) = .02, p > .05. When the scores of the individual subtests were entered into the multiple regression analysis separately, the amount of variance explained by nonverbal and verbal classification rose to 1.7%, F (6,77) = 1.97, p > .05. This amount approached significance at the .05 level. The results of the stepwise multiple regression analysis with the classification subtests entered separately are summarized in Table 3.

Insert Table 3 about here

Conclusions and Discussion

The major conclusion drawn from this investigation was that the effect of nonverbal and verbal classification on reading comprehension as measured by recall is too small to be statistically significant when IQ is controlled. Although nonverbal classification explained more of the variance of reading recall than did verbal classification (.37% and .02%, respectively), this difference was probably due to an overlap in the amount of variance explained by both IQ and verbal classification (the correlation between IQ and verbal classification was .33). The measures of classification designed for this study should not be used as a screening device with large groups of students. They might be used as an additional diagnostic tool when working with individuals with reading comprehension problems. If they are used, however, the individual subtest scores should be considered separately, as they provide more information than the total scores.

Further research could be conducted on this topic. In order to test the hypothesis that classification is an important factor for children who are average or above average in intelligence but low in reading comprehension, it would be necessary to have a large population with a normal distribution of IQs. Three groups could be selected: high IQ/low comprehension; average IQ/low comprehension; and low

IQ/low comprehension. The relative effects of classificatory ability on comprehension for these three groups could be measured. Recall could be measured in two ways: by asking the subject to summarize the story, and by asking for answers to specific questions. The effects of classificatory ability on these two types of comprehension measures could be compared. An expository rather than a narrative reading selection might be used, since expository writing usually follows a classificatory pattern, whereas narration is sequential.

Future researchers could utilize some of the techniques used in the present investigation to study the differences between normal and handicapped readers. It would be interesting to study possible differences in the ways that normal and handicapped readers delineate and rate pausal units. Fourth-grade students could be asked to delineate pausal units, and the investigator could study the relationship of their choices of units to the structure of the English language. The rating of the units as to level of importance might provide insights into differences in the ways that normal and handicapped readers order information. It would be interesting to use the classification tasks of the present investigation with a special population, in order to see whether the correlations between the scores of the nonverbal and verbal portions of individual subtests would be higher or lower than those obtained with a normal population.

The method of rating level of importance which was used in this investigation could be developed as a measure of classification ability for students in the fourth grade and beyond, using expository reading selections. Classification tasks such as those used in the present investigation are more concrete, and may not measure abstract conceptualization abilities of students beyond the primary grades.

Finally, it is the belief of this investigator that further research should be conducted on the effect of cognitive organization on reading comprehension without controlling for IQ. Since IQ is such a large construct, made up of many more specific abilities (Guilford [1967] in his model of the intellect isolated 120 individual structures), investigations such as the present one in which an attempt is made to factor out the effect of intelligence are unlikely to result in significant findings. In attempting statistically to remove the effect of IQ, the investigator may at the same time be removing the effect of any smaller construct which s/he is studying. Classification ability may be found to be significantly related to reading comprehension when considered as a separate entity without attempting to control for the effect of IQ.

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Table 1

IQ, Recall and Classification Scores

	Mean	Median	SD	Maximum Possible Score
IQ	116.6	117.2	15.2	--
Recall	14.1	14.8	6.0	34
Shifting NV	23.8	25.2	7.3	30
Shifting V	24.3	26.2	7.3	30
Free Sort NV	19.5	15.1	8.9	35
Free Sort V	24.7	25.7	6.3	35
Level 1 NV	9.9	9.9	6.6	10
Level 1 V	28.7	29.3	4.2	35
Level 2 NV	9.2	9.9	2.1	10
Level 2 V	29.0	30.0	6.5	35
Level 3 NV	5.2	3.1	6.9	15
Level 3 V	9.9	2.7	13.3	35
3-Level NV	24.3	20.3	7.7	35
3-Level V	22.5	21.4	5.9	35
Total NV	67.3	65.3	16.4	100
Total V	71.6	72.6	14.5	100

KEY NV = Nonverbal
V = Verbal

Table 2

Hierarchical Multiple Regression with Reading Recall Score as the Dependent Variable and Three Independent Variables

Step	Ind. Var.	Simple R	Mult. R	RSQ	RSQ Change	B	BETA	df	F
1	IQ Score	0.4487	0.4486	0.2013	0.2013	0.1734	0.4502	1 83	20.919**
	Verbal Classif. Score	0.2015	0.4489	0.2015	0.0002	-0.1701	-0.4509		
2								1 81	0.444
	Nonverb. Classif. Score	0.2059	0.4537	0.2059	0.0044	0.3267	0.0857		
	(Constant)					-7.2301			

*p < .05.

**p < .01.

Table 3

Stepwise Multiple Regression with Reading Recall Score as the Dependent Variable and Seven Independent Variables

Step	Ind. Var.	Simple R	Mult. R	RSQ	RSQ Change	B	Beta	df	F
1	IQ	0.449	0.449	0.201	0.201	0.178	0.178	1 83	20.92**
2	Shift of Crit. V.	0.148	0.456	0.208	0.006	0.124	0.124	1 82	0.66
3	Free Sort NV	0.056	0.459	0.210	0.003	0.387	0.387	1 81	0.28
4	3 Level V	0.091	0.462	0.213	0.003	0.832	0.832	1 80	0.31
5	3 Level NV	0.082	0.464	0.216	0.002	0.419	0.419	1 79	0.20
6	Free Sort V	0.117	0.466	0.217	0.002	0.387	0.387	1 78	0.17
7	Shift of Crit. NV	0.124	0.467	0.218	0.001	0.538	0.531	1 77	0.06
	(Constant)					-7.465			

*p < .05.
**p < .01.

V = Verbal
NV = Nonverbal